1. A ICP source for a semiconductor wafer processing apparatus comprising:

an RF generator;

a series RF circuit that includes a substrate support surface and the peripheral ionization source coupled to the substrate support;

a matching network coupling the RF generator into the series circuit; and

the RF generator coupling RF energy to the series RF circuit to bias the substrate support surface to capacitively couple to a plasma proximate the substrate support surface and to energize the peripheral ionization source to inductively couple to the plasma.

2. The ICP source of claim **1** wherein:

the peripheral ionization source includes at least one inductive element that generates an RF magnetic field into the plasma; and

a slotted Faraday shield between the inductive element and the plasma for facilitating the inductive coupling of energy from the inductive element into the plasma and for impeding the capacitive coupling of energy from the inductive element to the plasma.

3. The ICP source of claim **1** wherein:

the peripheral ionization source includes an annular inductive element that surrounds the substrate support surface.

4. The ICP source of claim **1** wherein:

the peripheral ionization source includes an annular antenna that surrounds the substrate surface and is capacitively-coupled in series with the substrate support surface to form the RF series circuit.

5. The ICP source of claim **1** wherein:

the matching network is connected to an output of the RF generator; and

the peripheral ionization source is capacitively connected at one end thereof to the matching network and is capacitively-coupled at an opposite end thereof to the substrate support surface.

6. The ICP source of claim **1** wherein:

the matching network is capacitively-coupled to the substrate support surface; and

the peripheral ionization source is capacitively-coupled to the substrate support surface and is capacitively-coupled to the chamber ground.

7. The ICP source of claim **1** wherein:

the substrate support surface is an electrostatic chuck.

8. The ICP source of claim **1** wherein:

the RF generator is the sole source of RF energy to the substrate support surface and the peripheral ionization source.

9. The ICP source of claim **1** wherein:

the peripheral ionization source is capacitively-coupled to the substrate support surface; and

the matching network has impedances in series with the peripheral ionization source that are approximately tuned to the frequency of the RF generator.

10. The ICP source of claim **1** wherein:

the peripheral ionization source is configured to inductively couple RF energy into the plasma to form a high density ring-shaped plasma concentrated in the direction of the perimeter of the substrate support surface.

11. The ICP source of claim **1** wherein:

the matching network is capacitively-coupled to the substrate support surface;

the matching network has an input and an output and includes an inductor connected in series between the input and output; and

the peripheral ionization source is connected in series with the inductor of the matching network.

12. The ICP source of claim 1 wherein:

the matching network is capacitively-coupled to the substrate support surface;

the matching network has an input and an output and includes an inductor connected in series between the input and output; and

the peripheral ionization source is connected in parallel with the inductor of the matching network.

13. The ICP source of claim 1 wherein:

the matching network is capacitively-coupled to the substrate support surface; and

the matching network has an input and an output and has the peripheral ionization source connected in series between the input and output in lieu of a separate inductor.

14. The ICP source of claim 1 wherein:

the matching network is capacitively-coupled to the substrate support surface;

the matching network has an input and an output and has the peripheral ionization source connected in series between the input and output in lieu of a separate inductor; and

the peripheral ionization source includes individual inductive elements connected in series through stray mutual capacitance.

15. The ICP source of claim **1** wherein:

the peripheral ionization source has a segmented configuration of alternating high and low-radiation sections arranged in a ring and positioned to couple power in an annular alternating high and low power distribution.

16. The ICP source of claim **15** wherein:

the shield has a segmented configuration of alternating high and low-transparency sections arranged in a ring and positioned to facilitate the coupling of power therethrough in the annular alternating high and low power distribution;

the high-radiation sections of the peripheral ionization source include the high-transparency sections of the shield; and

the low radiation sections of the peripheral ionization source include the low-transparency sections of the shield.

17. The ICP source of claim **16** wherein:

the source includes an antenna having a segmented configuration that includes a plurality of spatially concentrated conductor segments thereof parallel to the dielectric chamber wall and perpendicular to the slots and aligned with the high-transparency sections of the shield, and a plurality of spatially distributed conductor segments aligned with the low-transparency sections of the shield; and

the high-radiation sections of the peripheral ionization source include the spatially concentrated conductor segments and the low radiation sections of the peripheral ionization source including the low-transparency sections of the shield.

18. A ICP source for a semiconductor wafer processing apparatus comprising:

an RF generator;

a substrate support surface;

a peripheral ionization source surrounding the substrate support surface ; and

the peripheral ionization source has a segmented configuration of alternating high and low-radiation sections arranged in a ring and positioned to couple power into a plasma over the substrate support surface in an annular alternating high and low power distribution.

19. The ICP source of claim **18** wherein:

the peripheral ionization source includes a shield having a segmented configuration of alternating high and low-transparency sections arranged in a ring and positioned to facilitate the coupling of therethrough in the annular alternating high and low power distribution;

the high-radiation sections of the peripheral ionization source include the high-transparency sections of the shield;

the low radiation sections of the peripheral ionization source include the low-transparency sections of the shield;

the high-transparency sections of the shield have a plurality of slots therethrough; and

the low-transparency sections of the shield are electrically conductive and generally solid relative to the high-transparency sections.

20. The ICP source of claim **19** wherein:

the source includes an antenna having a segmented configuration that includes a plurality of spatially concentrated conductor segments thereof parallel to the dielectric chamber wall and perpendicular to the slots and aligned with the high-transparency sections of the shield, and a plurality of spatially distributed conductor segments aligned with the low-transparency sections of the shield;

the high-radiation sections of the peripheral ionization source include the spatially concentrated conductor segments; and

the low radiation sections of the peripheral ionization source include the low-transparency sections of the shield.

21. A semiconductor wafer processing method comprising:

providing a substrate support in a vacuum chamber having a surface thereon for placement thereon of a semiconductor wafer for processing with a plasma;

coupling RF energy from an RF generator through a matching network into a series RF circuit that includes the surface of the substrate support and a peripheral ionization source surrounding the substrate support; and

coupling RF energy from the substrate support to a plasma proximate the substrate support.

22. The method of claim **21** further comprising:

energize the peripheral ionization source with the RF energy and inductively coupling energy therefrom to the plasma.

23. The method of claim **21** further comprising:

biasing the surface of the substrate support with the RF energy and controlling ions from the plasma thereby.

24. The method of claim **21** further comprising:

inductively coupling RF energy into the plasma from the peripheral ionization source and forming a high density ring-shaped plasma concentrated toward the perimeter of the substrate support surface.

25. The method of claim **21** wherein:

the peripheral ionization source has a segmented configuration of alternating high and low-radiation sections arranged in a ring; and

the method further comprises inductively coupling RF energy into the plasma from the peripheral ionization source and forming a segmented high density ring-shaped plasma concentrated toward the perimeter of the substrate support surface positioned to couple power in an annular alternating high and low power distribution.